Army Communications Science & Technology for the Objective Force

Armaments for the Army Transformation
20 June 2001

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CECOM Bottom Line: THE SOLDIER

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
20062001	N/A	-

Title and Subtitle Army Communications Science & Technology for the Objective Force	**Contract Number**
	Grant Number
	Program Element Number
Author(s) Fiuza, Antonio	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) CECOM Research Development and Engineering Center (CERDEC) Space & Terrestrial Communications Directorate Ft. Monmouth, NJ	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es) NDIA (National Defense Industrial Association 2111 Wilson Blvd., Ste. 400 Arlington, VA 22201-3061	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)

Distribution/Availability Statement
Approved for public release, distribution unlimited

Supplementary Notes
Proceedings from Armaments for the Army Transformation Conference, 18-20 June 2001 sponsored by NDIA.

Abstract

Subject Terms

Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU

Number of Pages
17

Communications & Networking Development Philosophy

Adopt Commercial off the shelf Technology

Adopt

• **Personal Communications Services (PCS)**

Adapt Commercial Technology When It Cannot Be Directly Inserted

Adapt

• **PCS**
  - ✓ **Add Security**
  - ✓ **Downsize Base Station**

Develop Technology in Concert With Other Services and Agencies for Unique Areas

And Partnerships, Alliances, Teaming

Develop

• **PCS**
  - ✓ **Universal Handset**

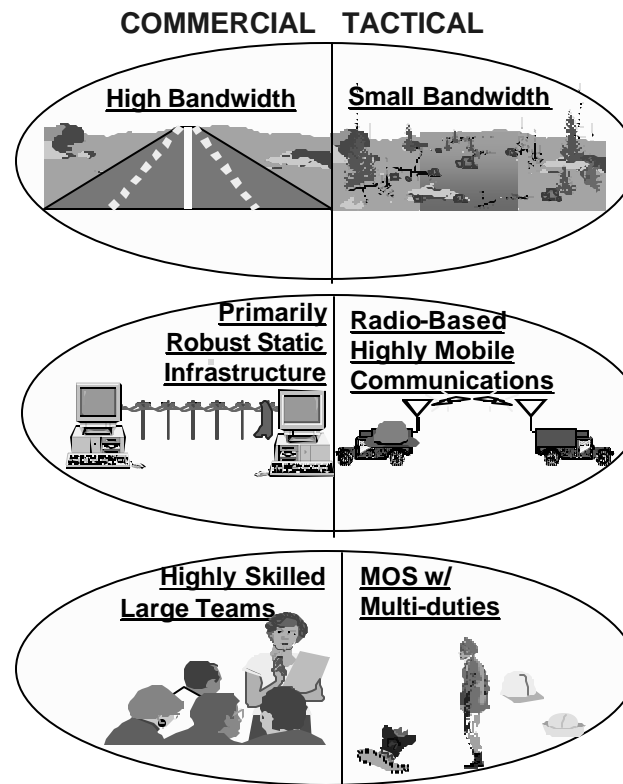**Need to Differentiate Technology vs Product**

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Commercial versus Military Communications Challenges

Commercial

- Mobile Subscriber, Fixed Infrastructure
- Pre-configured Networks
- Tall, Fixed Antenna Towers
- Fiberoptic Internodal Connections
- Greater Frequency Spectrum Availability
- Fixed Frequency Assignments
- Protection: None -> Privacy (single level)
- Interference Rejection is Somewhat Important
- Low probability of Detection (LPD) is not an issue

COMMERCIAL   TACTICAL

High Bandwidth   **Small Bandwidth**

Primarily Robust Static Infrastructure   **Radio-Based Highly Mobile Communications**

Highly Skilled Large Teams   **MOS w/ Multi-duties**

Military

- Mobile Subscriber - Mobile Infrastructure
- Ad Hoc, Self Organizing Networks
- Small, Easily Erectable Masts; Low Profile OTM Antennas
- Mobile, Wireless, Internodal Connections
- Restricted Frequency Assignments; Geographically Impacted
- Protection: None -> Top Secret/SI (Multiple, Simultaneous Levels)
- Interference Rejection and Antijam are Critical
- Low Probability of Detection (LPD) is Critical
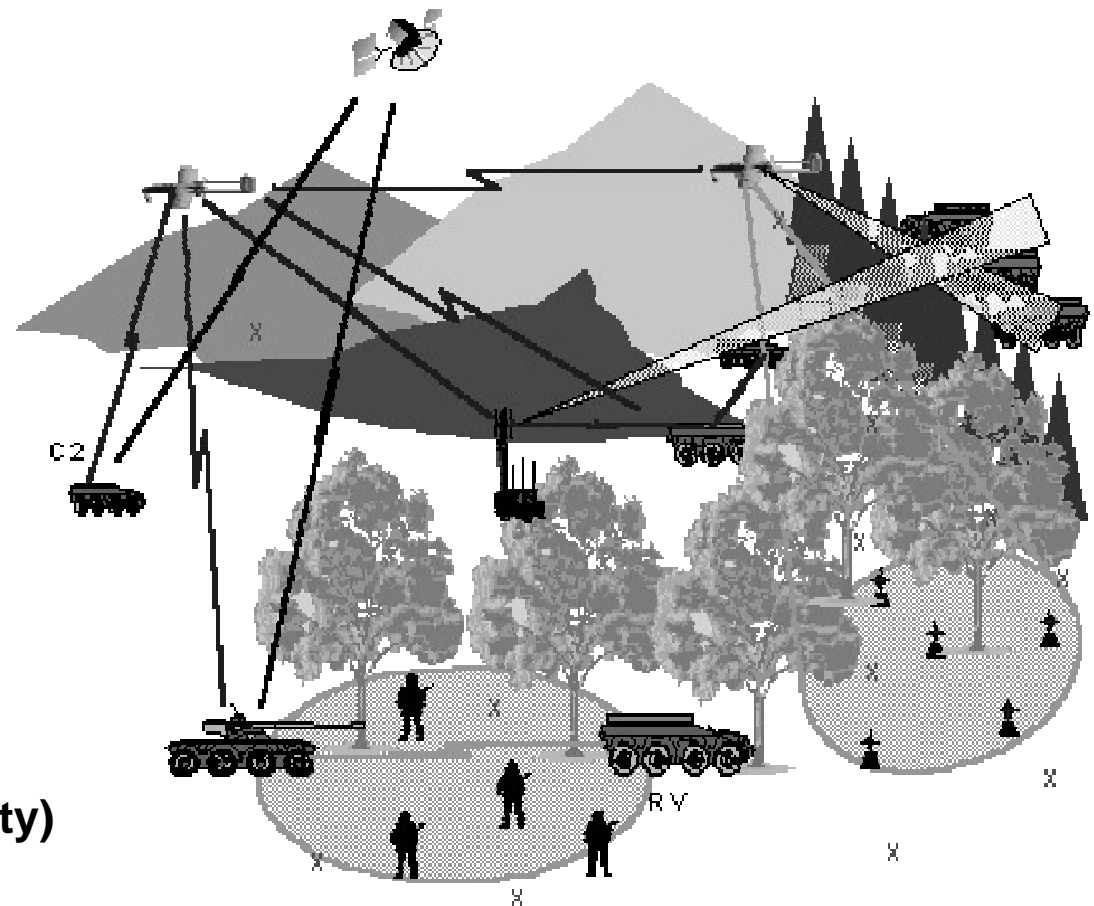
CECOM Bottom Line: THE SOLDIER

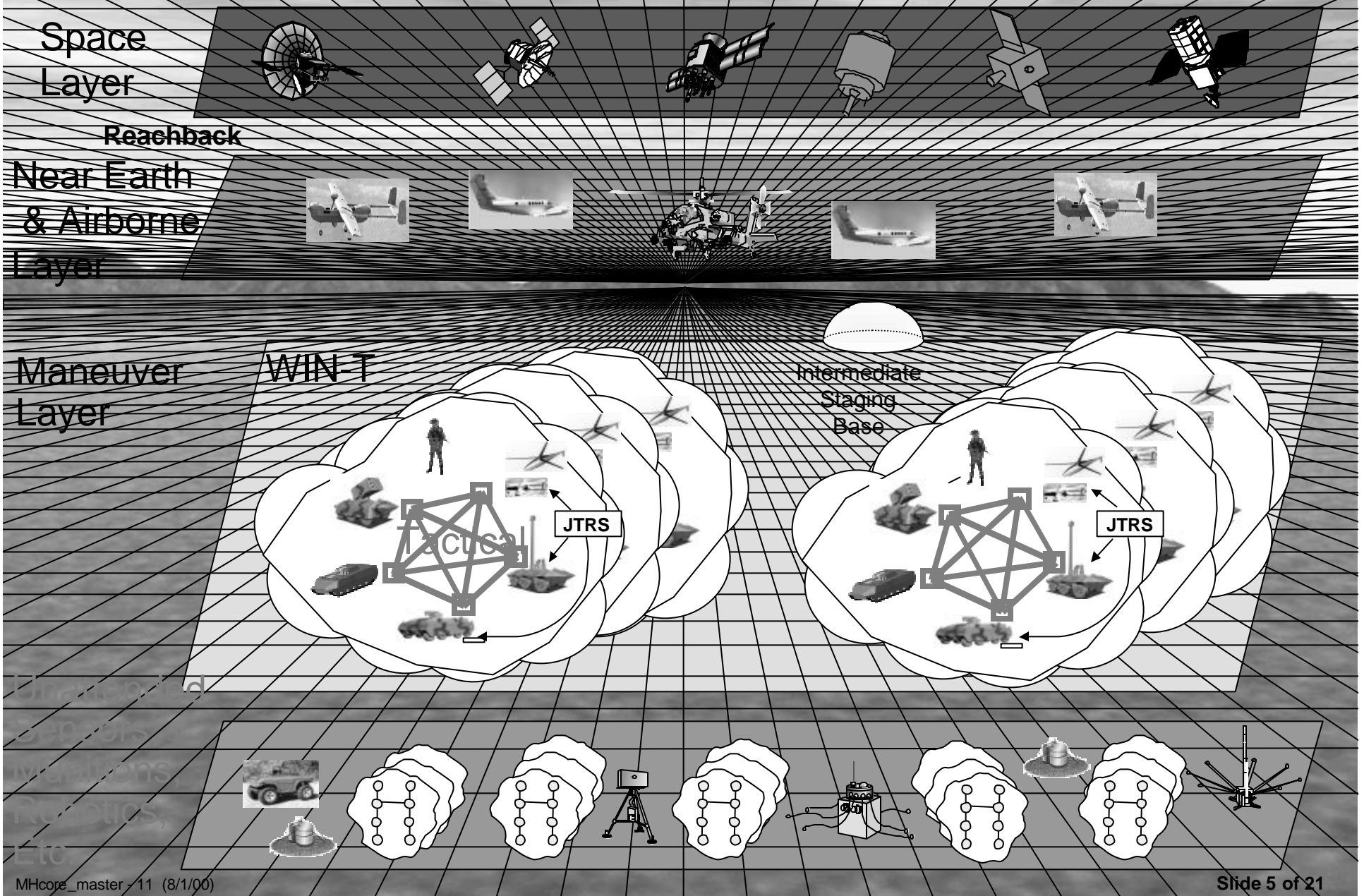# Communications Technology Challenges

Objective Force demands an assured, mobile, networked infrastructure that works in diverse complex terrain

- **Self-Organizing Networks**
- **High data rates**
- **Greater ranges/dispersion**
- **Real-time delivery**
- **Low-probability of detection**
- **Jam resistance**
- **Propagation effects**
  - **Terrain blockage**
  - **Foliage penetration**
  - **Urban "canyons"**
- **Context based routing (priority)**
- **Network Protection**

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Objective Force / FCS Network Grids

Space Layer

Reachback

Near Earth & Airborne Layer

Maneuver Layer

WIN-T

Intermediate Staging Base

FCS/C²

JTRS
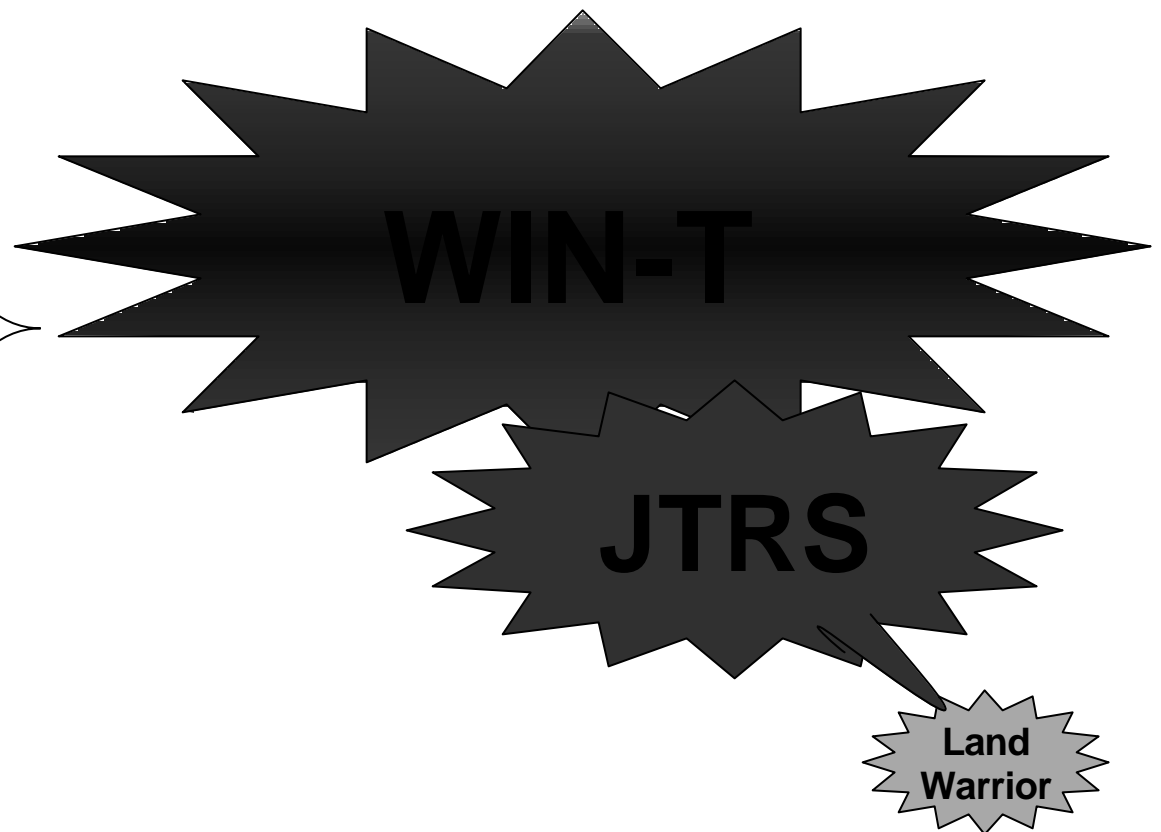
JTRS

Unattended Sensors, Munitions, Robotics, Etc.

Major Communication Thrusts

- **Secure On-the-Move Networking**
- **Reachback/Range Extension (SATCOM & UAV)**
- **Unattended Sensors Networking**
- **Secure Personal Communications**
- **Antennas**
- **Information Protection/Information Assurance**
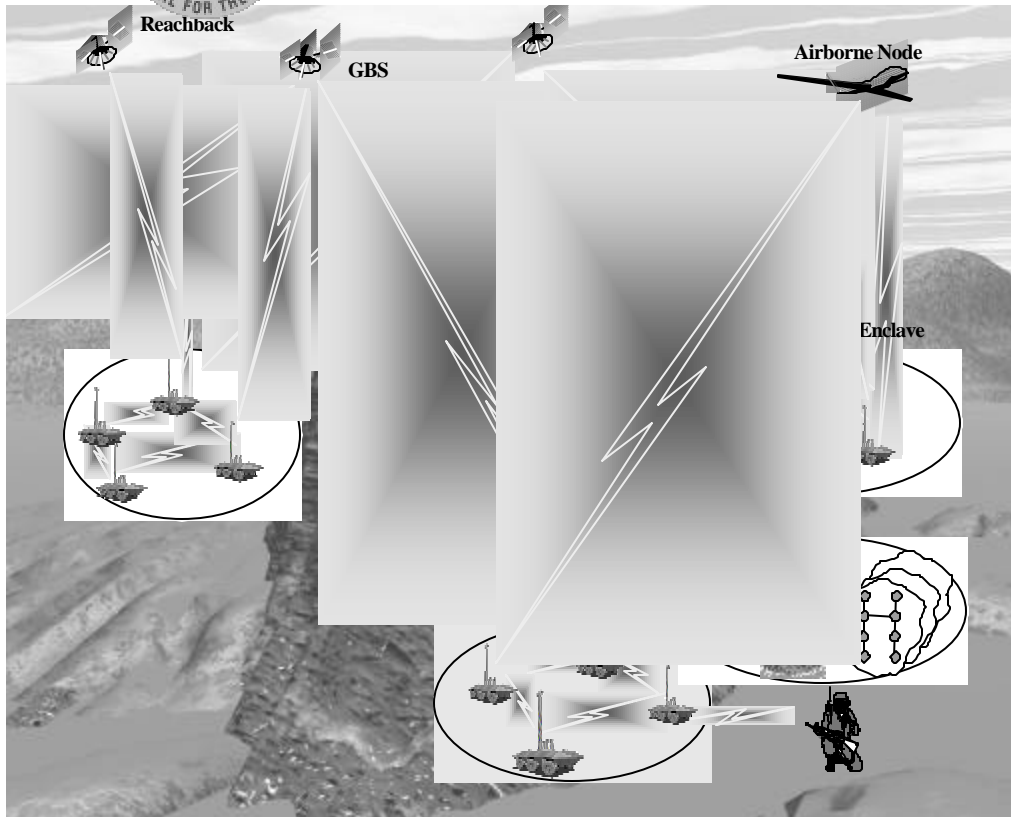 – **Networked Fires**

Programmed Objective Force Comms Systems

WIN-T

JTRS

Land Warrior

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On-the-Move Networking - Mobile Infrastructure

Reachback

GBS

Airborne Node

Enclave

MOSAIC ATD

- **Challenge:**
  - Provide an assured, wireless, network that works in diverse, complex terrain

- **Barriers:**
  - **Days** to preplan & configure network
  - Limited bandwidth for assured network access, services, & speed of delivery
  - Complex, dynamic, network mgmt
  - Continuous coverage

- **Solutions:**
  - **Minutes** to configure network via self-organizing Ad Hoc protocols
  - Efficient bandwidth utilization via adaptive algorithms
  - Simplified automated net ops using intelligent distributed agents
  - UAV Communications payloads

- **Collaboration:**
  - DARPA, Commercial, Other Services, Industry IR&D

Warfighter Payoff: Increased Responsiveness, Deployability, Agility and Versatility

MOSAIC

- **Multiple Contracts Awarded**
- **Modular demo in 02**
  - **6-10 vehicle & lab platforms**

- **Integrated demo in 04**
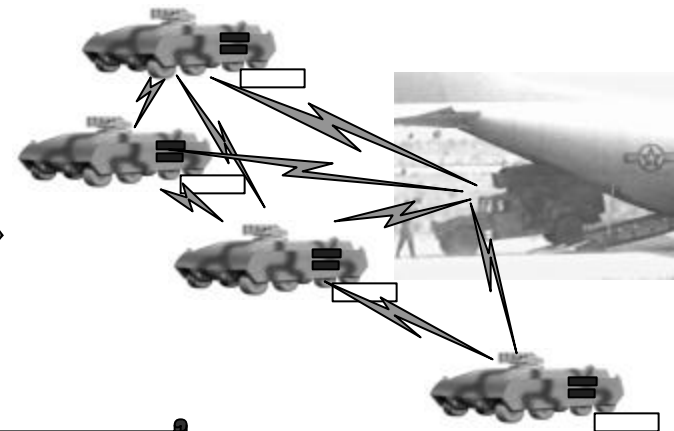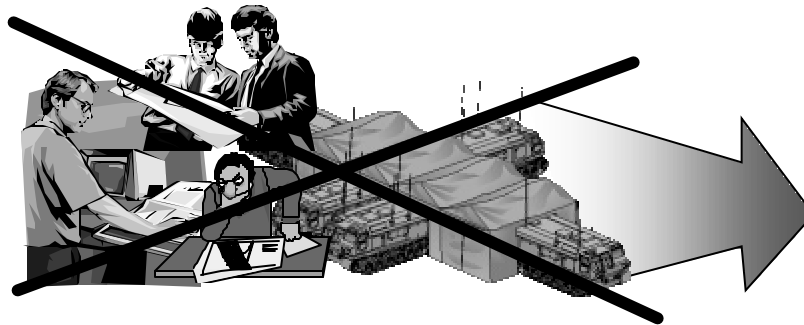 - **Relevant environment with Agile Commander ATD**

Breadboard Test -TRL 5

- **Lab test environment**
  - **Limited dynamics**
  - **Simulation for scalability**
- **Demonstrates Technical approach**
- **Identifies Integration/ Interface issues**

TRL 6

- **15-20 nodes, vehicle & fixed with Surrogate UAV**
- **Integrated with other STOs**

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# On-the-Move Tactical SATCOM Technology

Objective: **Enable on-the-move SATCOM for military and emerging commercial satellites which recovers quickly from signal blockages due to man made objects, terrain/foliage, weather and other atmospheric effects**

REACHBACK

MILSTAR

Wideband LEO/MEO

Wideband GEO

Applications:

- **Scouts:** MILSTAR OTM comms at 9.6 kbps
- **C2 Node to C2 Node:** Wideband OTM comms at 5 Mbps Rx, 256 kbps Tx

Major efforts:

- Blockage mitigation (voice & data)
- Rapid Satellite acquisition and reacquisition
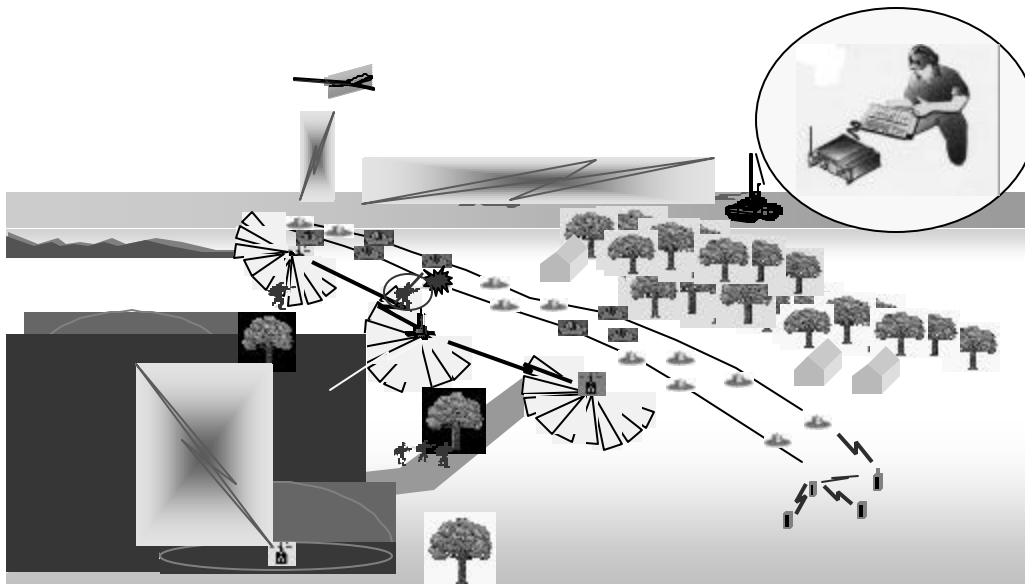- Turbo Codes
- Integration
- OTM Assessment

Wideband OTM

Protected OTM

Protected OTM
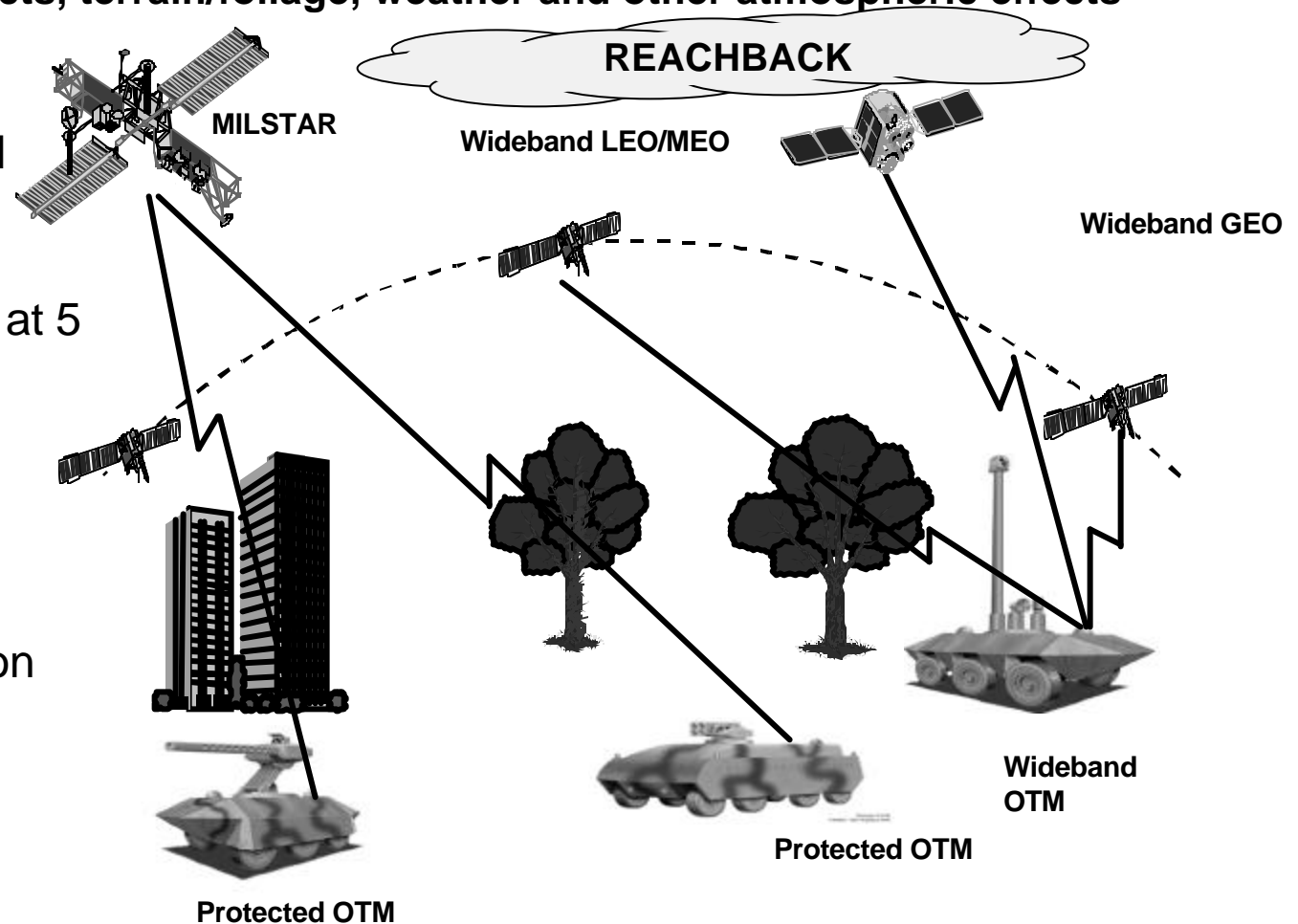
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Networked Sensors for the Objective Force Communications

Objective: Develop a robust secure jam resistant, stealthy communications network for unattended devices

Pacing Technologies:
- Low-power, small efficient fast signal correlators
- Jam-resistant, LPI/LPD waveforms
- Energy-efficient networking protocols and channel access

Warfighter Payoffs:
- Enhanced Survivability
- Improved Situational Awareness --- quicker reaction, broader coverage, better identification

A Secure, Stealthy, Robust, Power Efficient Miniature Radio and Network
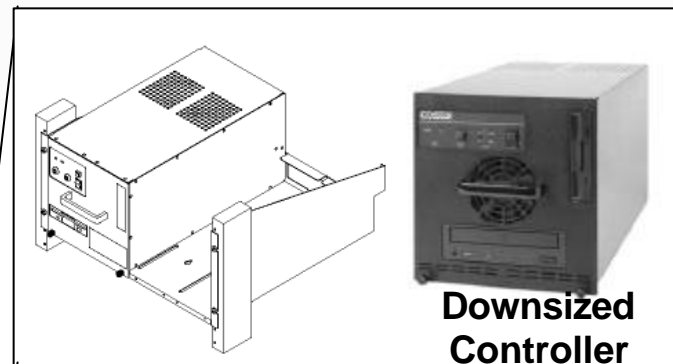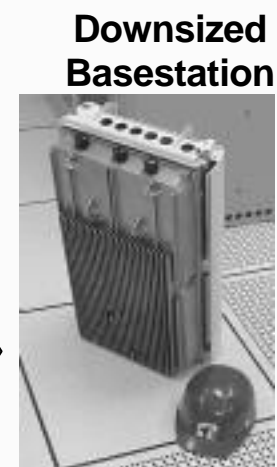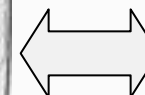
Terrestrial PCS (Example)

Downsized Controller

Bridge Switch Node

Downsized Basestation

Commercial Basestation Controller

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Universal Handset Technology

Terrestrial/ACN Cellular (Multi-band 800/900/1900) and SUO-SAS (200-800)

Mobile Satellite System

Bluetooth Air Interface

Secure Multi-band Multi-mode Handsets

One-Touch Internet Access

Netted mode and Group Services

Antenna Cover

Cellular Antenna

Peer-to-peer w/ ad hoc networking - SUO-SAS

Full motion video

Battery Casement

SCALE: 0.725 (Approx.)

P2P Antenna

MDR/LDR data and extended display ports

Type I - Type IV Security

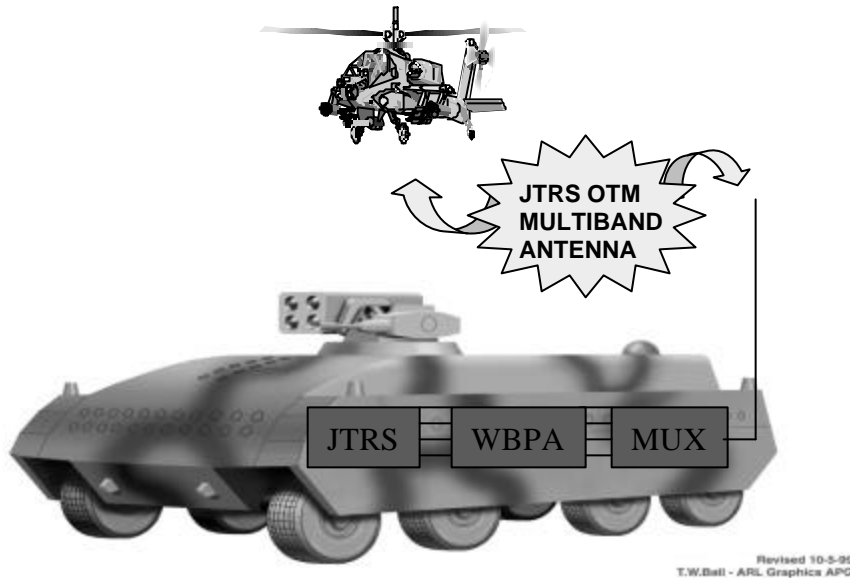Super sensitive, rapid acquisition P/Y code GPS

Plus: standard cell phone features such as hands-free operation, voice recognition, and button memory dialing

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Tactical Antenna Technologies

JTRS Multiband On-The-Move (OTM) Antenna

JTRS OTM MULTIBAND ANTENNA

JTRS | WBPA | MUX

Revised 10-5-99
T.W.Ball - ARL Graphics APG

- **JTRS Critical Component**

- **Tactical OTM LOS Scenarios**
  – **Ground, Airborne**

- **30 - 450 MHz**

- **400-2000 MHz**

- **High Power Capability**

Technologies

- **Dual mode VHF/UHF Dipole/Monopole**
- **Distributed Reactive Tuning**
- **Multielement Radiating Structures**
- **Coaxial & slotted traps**

- **Genetic algorithm optimization**
- **Taped resistive loading**
- **Lumped circuit loading**
- **Distributed LRC Networks**
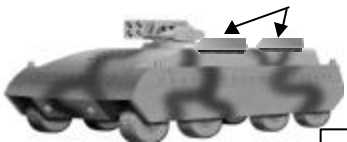
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Ferroelectric Phased Array
(Wideband OTM)

TODAY (Static)

RCV / XMT ARRAYS

TOMORROW (Mobile)

- **Challenge**
  - Enable OTM non line-of-sight communications via UAV and SATCOM

- **Barriers**
  - Supporting multiple beams simultaneously
  - Very expensive construction methods
  - Size and complexity
  - Off road tracking stability

Material Breakthrough!

- **Solutions**
  - Revolutionary low profile, wideband, cost effective antennas using Ferroelectric materials
  - Sophisticated tracking algorithms
  - Micro Electro Mechanical Systems (MEMS) integrated with interferometric GPS

High Availability, Wideband, OTM, Beyond Line-of-Sight

Program Concept Chart
Tactical Information Assurance Technology

(CER-01)

Objective: Adapt and Develop Critical Information Assurance Components to Insure Network Availability Despite Increasing Threats

Total Program $24.3M

OPM $120M

Pacing Technologies:

- Advanced Network Access Control

- Next Generation Intrusion Detection

- Synchronized Security Management

- Tactical Public Key Infrastructure

- Mobile Code Authentication

Prevent

MGMT

Predict

Detect

Survive

Network Intruder

Insider Threat

Overrun/Capture
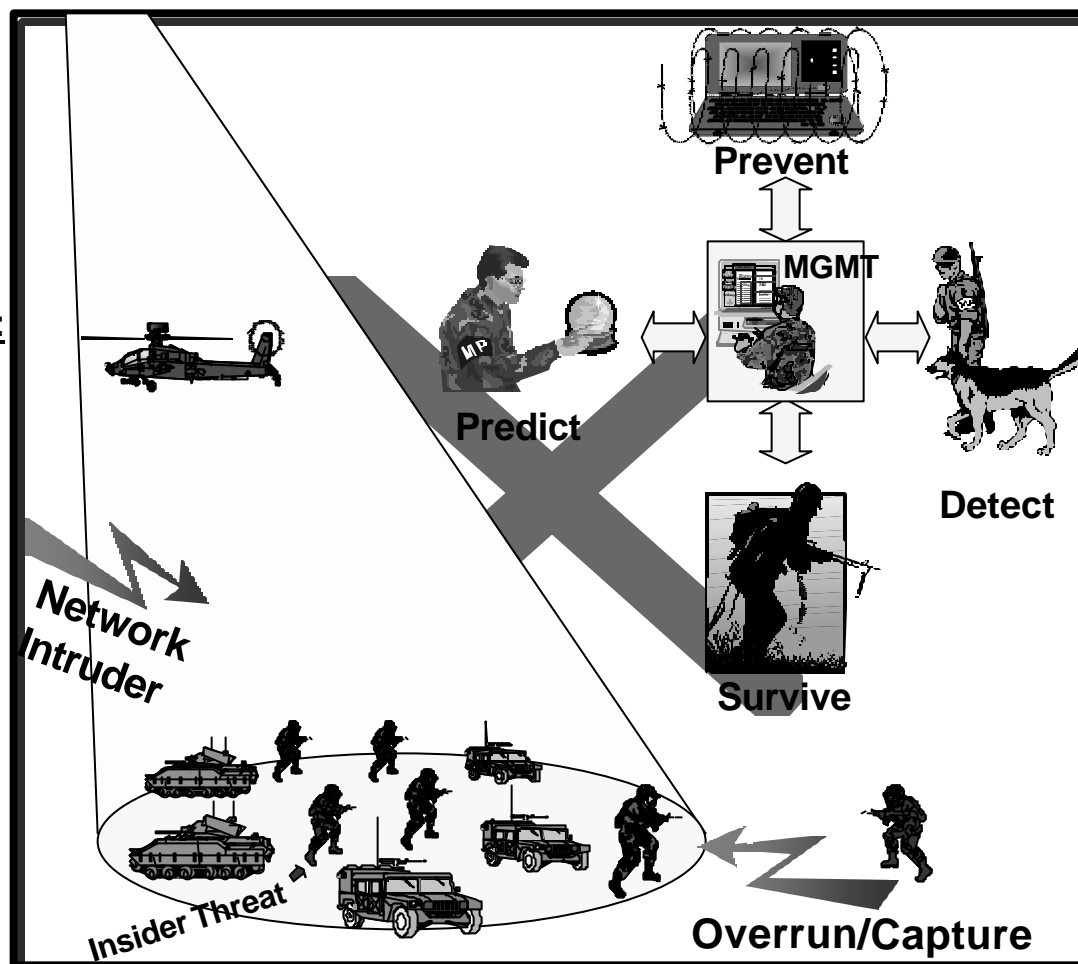
Warfighter Payoffs:

- Increased Warfighter Confidence to Prosecute Battle

- Reduced Vulnerabilities In Objective Force Networks

- Limit Compromise in Overrun Situation

- Effective Security Management to Avoid Personnel Increase

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2/27/01

Networked Fires

Objective

Provide high speed networked communications to enable standoff precision high volume/rate of fire engagements

In-flight updates via network enables munition retasking

No dedicated data links

Priority/Precedence Protocols for Fire Missions

Networking of unattended sensors and robots to inflight munitions and missiles

Current:
- **Program Concept in Development**

Speed of Service

Multi-role Armament System

BLOS & NLOS Engagement

Networked Maneuver C2 and Fire Support

Detection and image data to FCS from Sensors

Enable One Shot One Kill

CECOM/ AMCOM/ ARDEC

It's a Network Centric World!

Right info...

Right time...

Right warfighter.